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Abstract

Information modeling is a technique by which a database designer determines the types of information that should be included in a database. Unknown to the database designer there are a variety of implicit metaphysical assumptions that guide the model construction and affect the quality of the resulting model. The broadest characterization of these assumptions is realism verses conceptualism. The realist believes that the object classes exist in the application domain waiting to be discovered. The conceptualist believes that object classes are abstracted from the application domain based on observations about the domain and the objectives of the information model. This paper explores these two dimensions of metaphysical assumptions and their implications.

Introduction

Information modeling is a technique by which a database designer can determine the proper information contents of a database at the conceptual level. "At the conceptual level" means that the information model represents the information contents of the database as the users view it, rather than as a collection of database record types. The database designer constructs the information model by interviewing potential database users about their information needs; and the resulting information model is a record of the objects of interest in the application domain, important attributes of those objects, and the significant named relationships between those objects. A subtle but important point is that the information model actually models object classes rather than objects. Objects are instances and object classes are groupings of instances based on commonalties. This subtle point gives rise to a fundamentally important philosophical question: Do object classes exist in the world, or are they constructed in the mind of the observer ? This is an important question because the way in which one answers it has a profound impact on information modeling research and practice.

If object classes exist in the world, independent of the mind of the observer then the job of the information modeler is to discover those classes and record them in an information model. If two modelers study a domain and come up with different models, then one or the other (or both) simply have to bring their models into conformance with the real world. Further, an information model can be validated by ensuring its conformance with the real world. If one holds this position, then the work of researchers in information modeling is to develop more sophisticated representation techniques to more accurately represent classes as they exist in the world, and the practice of information modeling focuses on the discovery of these classes.

If classes do not exist in the world, then it is the job of the information modeler to construct them. Class construction could be highly individualized due to the variety of experiences and other different individual characteristics of different modelers. Different models of an application domain might be neither right nor wrong, only more or less appropriate to the problem at hand. This leads to a problem in validating an information model, since it cannot be compared with entities existing in the real world. It can only be evaluated with respect to the objectives of the model. This becomes a sticky problem because it requires that model objectives be defined before model construction and it requires some method of evaluating a model with respect to a set of objectives. If one holds this position, then the work of researchers in information modeling is to understand how classes are constructed to satisfy different objectives and how the individual differences between modelers may affect the models being produced. The practice of information modeling then focuses on the construction rather than the discovery of entity classes.

The question of whether or not classes exist in the world is not unique to information modeling. It is one of the central problems in metaphysics known as the problem of universals. From a metaphysical perspective there are individual things in the world called particulars. We group the things into categories which we call universals. The problem of universals addresses the issue of how we get from particulars to universals and how we know that a given particular belongs to a given universal. Since this distinction is often glossed over in ordinary language, discussing the problems of universals can be tricky and confusing. For example, one version the problem of universals can be stated as such - Is a tree a tree because it is a member of the set of trees, or is it a member of the set of trees because it is a tree.

Fortunately, examples of this issue are actually quite common in information systems. In typed programming languages, every variable must be a variable of some type. In a relational database, every record must be a record of some type. We know that a variable 'I' is an Integer because 'I' was declared as an Integer. 'I' is a particular and **Integer** is a universal. The problem of universals does not exist in a typed programming language because no particulars can be introduced without assigning them to a type (universal). However, particulars found in the real world, such as the objects recorded in an information model, do not come with a type assignment. Their types must be determined in order to group them. The problem is exacerbated by the fact that particulars found in the world do not have the uniformity of properties that variables have in a typed programming language. This makes the problem of grouping particulars and assigning them to universals a little more difficult.

The problem of assigning individual objects (particulars) to the appropriate class (universal) has been debated by philosophers as far back a Plato. Yet it is still a central problem in modern information modeling.[Artz] In fact, excerpts taken from some of the greatest philosophers in history could, if not referenced, be easily mistaken for excerpts from a textbook on information modeling or object-oriented analysis.

Position on Universals and Their Implications

There are two dimensions of this problem as it applies to information modeling: class realism vs. class conceptualism and attribute realism vs. attribute conceptualism.

Class Realism – The class realist believes that classes actually exist in the world for anyone to discover. The class realist attempts to discover the set of classes that exist in a domain by examining the domain; and the validation criteria for a model created by a class realist is that it represent the classes as they exist in the real world. There is no possibility that class formation is influenced at all by the cognition of the observer, because the classes can be discovered and verified objectively. If class realism holds, then there can only be one correct information model for any given domain - the one that accurately models the real world. Although this metaphysical position is quite prevalent among information modelers, there is little philosophical support for it. It is a modern day version of Platonic idealism in which classes exist in some nonmaterial world waiting to be apprehended by the intellect. Even Plato, who originated the position, had quite a bit of trouble with it.

Class Conceptualism – The class conceptualist believes that classes are constructed in the mind of the observer through some cognitive process of abstraction based on cues derived from the real world. If class conceptualism is correct, then class formation may be influenced by a wide variety of social and cognitive factors that may influence the abstraction process. Further, validation becomes very difficult. Since the model is the result of an abstraction process it is necessary to validate the resulting model using some criteria other than conformance to the real world. Philosophically, this position is more likely to be correct. However, it brings a host of new problems into the practice of information modeling.

Attribute Realism – The attribute realist believes that attributes or properties of individual objects exist in the world independent of the cognition of the observer. Classes can then be formed by grouping objects with like attributes. More rigorous approaches to information modeling adopt this position and there is some justification for it under a limited set of circumstance. There are two forms of attribute realism, limited and extended. Limited attribute realism suggests that objects have a limited set of properties and like objects can be grouped according to the commonality of those limited properties. Extended attribute realism suggests that objects have a virtually unlimited set of properties and grouping are formed based on common subsets of properties. If extended attribute realism holds, which is likely to be the case, then an abstraction process occurs when a small set of like attributes are selected for the grouping process. Once again, social and cognitive factors my influence the grouping process.

Attribute Conceptualism – The attribute conceptualist believes that attributes or properties of individual objects are constructed, once again, through a cognitive process of abstraction guided by cues form the real world. It may be reasonable to assume attribute realism in the case of physical properties of objects. However, attributes of objects that are functional in nature or define relationships between objects are more likely to be constructs. If attribute conceptualism holds, then attribute construction may also be influenced by a wide variety of social and cognitive factors that may influence the abstraction process.

Current Status and Future Directions

This research has potential for both theoretical and empirical research and thus both directions are currently being pursued. From a theoretical perspective further exploration of the metaphysical assumptions may help in determining both the implications of the above positions and the situations in which those assumptions are appropriate. Since it is likely that information modeling is influenced by both social and cognitive factors, further study of the psychology of concept formation and cognitive factors in information modeling may yield some insight into how we can avoid undesirable cognitive influences. Empirical studies of information modelers may help uncover hidden cognitive and social influences in the process of information modeling.

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